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Agriculture and Agricultural Science Procedia 3 (2015) 266 – 273
Agriculture and Agricultural Science Procedia

The 2014 International Conference on Agro-industry (ICoA): Competitive and sustainable Agro-industry for Human Welfare

Policy model of production and price of rice in Kalimantan Selatan

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Abstract

Kalimantan Selatan is one of the providers of rice in the region of Central Indonesia. Availability of rice needs to be managed properly in order to meet the needs of South Kalimantan and the surrounding area. Availability of rice means not only rice is available in the market but also the price factor needs to be considered that rice is available at an affordable price. The availability of rice affects regional stability, so that the government needs to design policies that can ensure the availability of rice at an affordable price. This study aimed to measure the impact of rice supply policy scenarios in Kalimantan Selatan in the perspective of affordability and availability of sufficient stocks of rice using system dynamics approach. Scenarios that developed are policies to support the portion of the budget to increase production of rice, guarantees the availability of spare rice policy and regional development policy of food diversification. Based on the simulation results, the budget policy scenarios on increased production should be maintained to ensure the number of stocks of rice, yet the scenario about production control, rice reserves, and food diversification have not been able to control the stability of the rice price in Kalimantan Selatan.

Peer-review under responsibility of Jurusan Teknologi Industri Pertanian, Fakultas Teknologi Pertanian, Universitas Gadjah Mada

Keywords: rice; system dynamics; policy,; price

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Peer-review under responsibility of Jurusan Teknologi Industri Pertanian, Fakultas Teknologi Pertanian, Universitas Gadjah Mada
doi:10.1016/j.aaspro.2015.01.051

1. Introduction

Rice is the staple food in Kalimantan Selatan. Rice management in Kalimantan Selatan has a important role to maintain regional stability (Somantri and Tahir, 2007). Based on the Central Statistics Agency data (BPS, 2013), the amount of rice production in Kalimantan Selatan surplus in 2012 - 2013. However, the price was fluctuative and hard to control. The increase in rice price has implications for the Kalimantan Selatan region of rising inflation in 2011 and 2012 (Kirnadi and Firahmi, 2010). According Somantri and Tahir (2007) and Kinardi and Firahmi (2010) rice has a very strategic role, especially in terms of food security. Kalimantan Selatan is a province that has the structure of the soil is less suitable for rice (Kirnadi and Firahmi, 2010) but managed to achieve a surplus. On the other hand, Kalimantan Selatan are still facing problems, especially in a unpredictable price. Uncertainties of supply and demand is causing the flow of rice are arduous to predict. Many factors affect the achievement of the availability of rice, such as the productivity of farmers, transportation, regulation, and so forth. In terms of rice availability not only can be produced to exceed the needs of public consumption quantitatively, but also includes affordable price with good quality. It is necessary for a review of the policy in the management of rice in Kalimantan Selatan.

This study will measure the impact of policy scenarios rice supply in Kalimantan Selatan about affordability and availability of regional rice stocks using a system dynamics approach. The policy alternatives were further tested the implications of the policy implementation through a simulation approach. Study of food policy in proposing food security in the region has been carried out (Georgiadis et al., 2004; Hidayatno et al., 2012; Irawan, 2005). According to Kumar and Nigmatullin (2011); Hu, et al, (2012) and Vorst et al. (2009) includes a quality food supply, entity integrity, health, sustainable production, food diversification, food-related information and security.

This research is the exploration of the Kalimantan Selatan government policy in managing the procurement of rice for the community through system dynamics modeling approach. This approach has been done in many areas (Tako and Robinson, 2012). Somantri and Tahir (2007) stated in his research that on the basis of a scenario-based simulation of system dynamics, Merauke in Papua could be the rice granary of eastern Indonesia. Suryani, et al (2013) conducted a behavioral analysis of demand and supply of rice in East Java using system dynamics approach. However, there are no studies that provide exploratory study of aspects such as demand and supply availability is associated with an affordable price of rice.

2. Research Method

System dynamics model has been used in this study. Mental data and secondary data had been used. The methodology in this study has been done through three stages. The first stage was problem identification. Furthermore, a study of the role of stakeholders and the last preparation of Causal Loop Diagram (CLD) and System Diagram, mental data and secondary data were processed to determine the relationship between one variable and the other variables (Walker, 2000). The second stage is system dynamics model development through the preparation of Stock and Flow Diagram (SFD), which is based on CLD. Then, validation and verification of the model will be conducted. The third stage is the testing scenario by simulation approach.

1. The assumptions used in this study: Model of rice management policy developed only in Kalimantan Selatan.
2. Population growth using historical data as well as using a linear projection.
3. The weather and disasters are not modeled.
4. Inventories rice has no effect on population growth.

3. Results and Discussion

Based on the study of the entity's role, the entity that has an interest in the cultivation of rice in Kalimantan Selatan was the Department of Agriculture who has a role as a regulator of rice production in the province. Food Security Agency (BKP) has a role as a maker of surveillance and food security policy development including food diversification. Bulog has a role in distributing subsidized rice to poor people. The Commerce Department has been involved in trade transactions to meet the needs of rice in the province. Causal Loop Diagrams created with the mental approach to the study of data obtained through the study that has been done before. CLD rice management system in Kalimantan Selatan is presented in Fig 1.

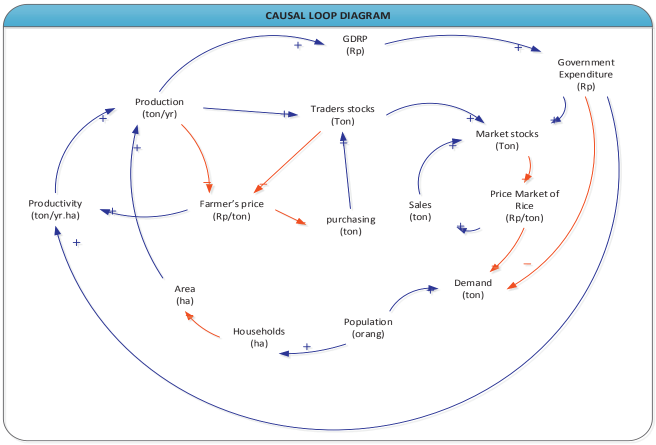


Fig. 1. Causal Loop Diagram Management of Rice in Kalimantan Selatan

The model presented in Fig 1 consists of four subsystems, namely subsystem GDRP, population, production-inventory, agricultural areas. In subsystem GDRP, the most important variable is government investment. Government investment is given to the three policies, namely productivity policies, increase the amount of rice in the market, and food diversification. This investment comes from government expenditures incurred on agriculture, especially rice. Government spending was derived from GDRP. The calculation of GDRP was derived from the total production of the system services, industry and agriculture. Capital service model was derived from field service productivity and then calculated from the intensity of capital services. Model subsystem industrial production comes from of any capital industry that produces the products.

The most important variable of population was the population subsystem itself. This population would increase with reduced birth and appropriate to the deaths that occurred. In addition, the difference in migration also serves as an addition to or deduction from the population factor.

In the production-supply subsystem, the most important variable was the stock traders and stock on the market which will then be issued how much the price on the market. Stock traders are influenced by production. Production comes from productivity changes every month and how much rice fields in Kalimantan Selatan to be a limitation. Stock traders can be reduced if the delivery occurred outside of the region and sales to the market. Stock market will increase in the event of deliveries outside the area. While stock markets may be reduced when demand increases. From the stock market will result in prices prevailing in the market. System diagrams created to explain how the system runs and explain the relationship of the system with the influence they might have on stakeholders. System diagram rice management in Kalimantan Selatan is presented in Appendix A. The concept of a model that has been described in terms of CLD, subsequently converted into the form of a dynamic models in the form of stock and flow diagram (SFD). The structure of the model that has been developed is presented in Appendix B.

3.1. Model Verification

The results of verification on the model are all variable already has the correct units. All units were show reality because there are no units to be corrected in software. The dimensions of the model run time are weekend. Selection of the time dimension is appropriate for the delivery of rice is generally done in a matter of weeks. Time step in this model is the day. Run time of the model run on time 01/01/2004 until 01/01/2024.

3.2. Model Validation

Test validation was used (Walker, 2000) a historical fit test, errors in extreme conditions and integration models.

3.2.1. Historical Fit Test

The results of behavioral tests in this simulation have the greatest deviation of less than 10% which is 9.46%. Validation was performed on variables of agricultural land, production, market demand, population. The validation results are presented in Table 1.

Table 1. Result of historical fit test

Variable	Unit(s)	Real data (2009)	Model value	Deviation (%)
Cultivation area	ha	507.315	439.433	9.46%
Production	ton	1.151.383	1.144.468	0.42%
Market Demand	ton	413.535	408.426	0.87%
Population	people	3.496.125	3.826.522	6.68%

3.2.2. Extreme Condition Test

The test is performed by evaluating the behavior that will occur when the input is changed in extreme conditions. Variables are visible on the stock trader. When the initial conditions of the initial stock is not equal to 0 (see Fig. 2.a) has the same behavior as the condition when the initial stock of the merchant equal to 0 (extreme), this behavior is presented in Fig. 2.b.

a b

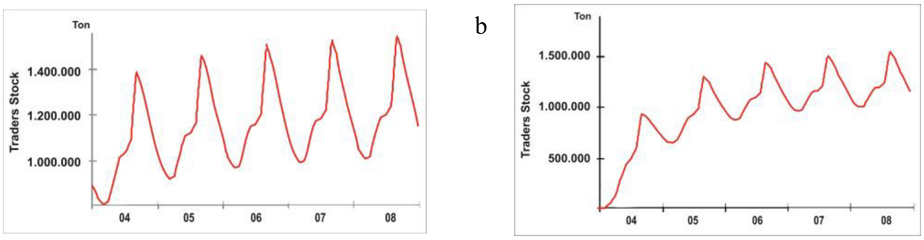
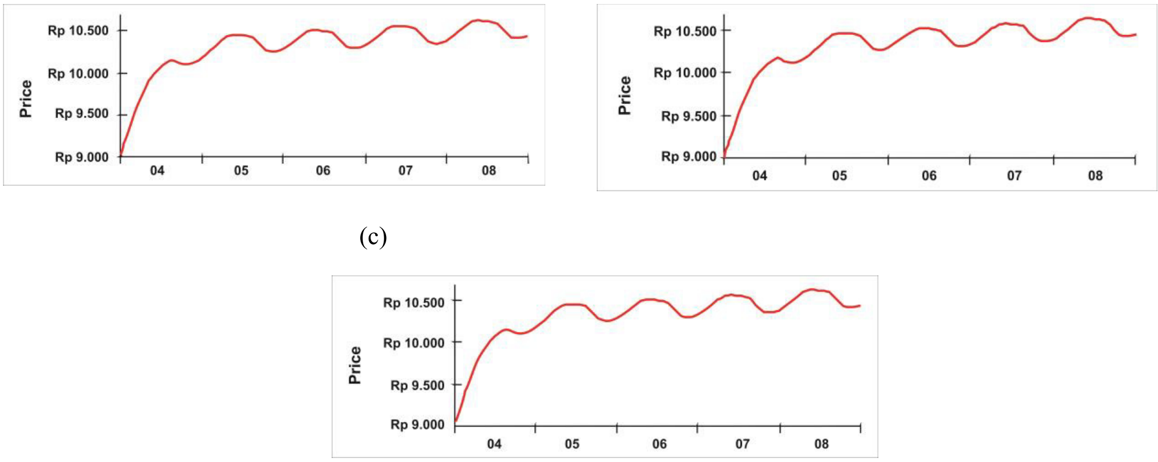


Fig 2. (a) Behavior of initial stock ≠ 0 (b) Behavior of extreme condition (initial stock = 0)

3.2.3. Error in Integration Model Test

Error in the integration is to examine the changes in the behavior of the model when the time step model of change. Time step used 2 times larger than the base model and a half times smaller than the initial model. The behavior of the model with the normal time step is presented in Fig 3.a, while the changes in time step when performed by 2-fold are presented in Fig 3.b, and for the behavior of the model time step is reduced to a half of the normal model is presented in Fig 3.c. The variables tested were variable price.

(a) (b)



(c)

Fig. 3. (a) The behavior of the model with a time step of normal (b) The behavior of the model with time step 2 times the normal model (c) The behavior of the model with a time step ½ of the normal model

The results can be seen in the behavior exhibited unchanged when timestep changed. Based on the results it can be said that this model passed validation error in the integration. Based verification and validation, it can be concluded that this model already represents the real world. This model can be used to simulate the problem of providing the policy and see if the effect of the policy. In addition, this model provides a model for developers learning about the dynamics prevailing in the system, which gives an overview of the influence of symptoms. This model can be used for subsequent studies.

3.3. Simulation

The government runs the policy in the cultivation of rice. The policy includes efforts to increase rice production through intensification and extension approaches, efforts to comply with local rice reserves through the purchase of rice from outside the region and the protection of the purchase price over the pricing of the government, as well as the movement of food diversification policy.

To determine the impact of these policies on the availability and affordability of rice in the future, then performed a simulated against the policy. The scenarios developed are:

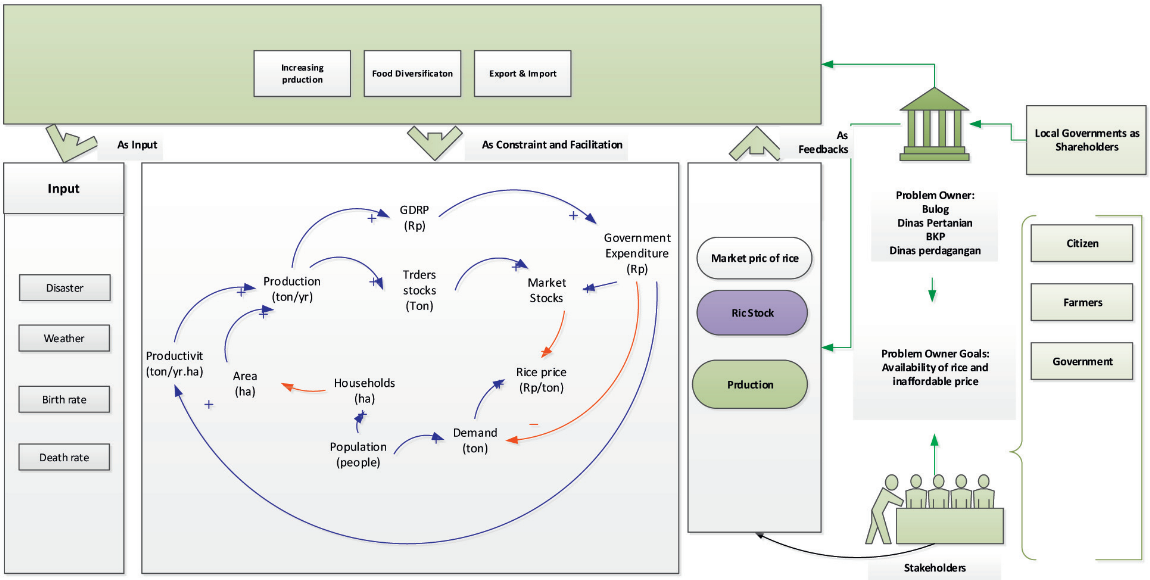
1. Policies production is allocated at 100% of the total government budget for agriculture cluster.
2. Policy backup supply of rice is allocated 100% of the total government budget for agriculture cluster.
3. Policies diversification allocated 100% of the government budget for agriculture cluster.
4. The government's budget is allocated evenly to all three policies, each of which is 33.33%.
5. Allocation for policy production by 70%, while for rice reserve stock policy and diversification policies respectively by 15%.
6. Allocation to reserve inventory policies rice by 70%, while for the policy and the policy of diversification of food production respectively by 15%.
7. The allocation for diversification policy by 70%, while for rice reserve stock policy and the policy of each production by 15%.

Based on the simulations on the seventh scenario can be said if the government wants to increase rice production in the extreme, the right to apply to Scenario 1, but with the implementation of a single policy in scenario 1 does not provide the level of price stability and the increase in the stock of rice in the market. All of the scenarios simulated have the same behavior only differ in the level of measured value or values. When the government wants the price of rice can be pressed at a certain level is using scenario 7, but it should be noted that the difference in price levels for each scenario does not provide a lot of difference. The whole scenario gives the rice stock market behavior that is relatively decreased. It is indicated there is a factor of rice wholesalers hoarding rice to trigger the price of rice increased, so as if the distribution of rice from traders to the market faltered. It required further study to answer this phenomenon. It can be used for further research to complete this study.

4. Conclusion

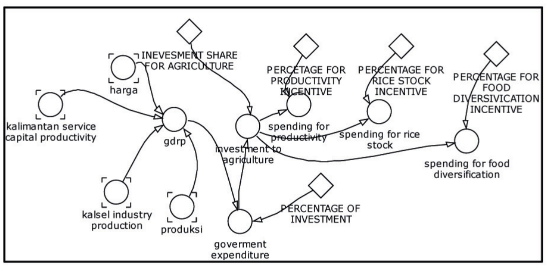
Based on a simulation model of the entire scenario has been created. The three strategic government policies that have been applied does not give significant results of stabilizing the price of rice in the market. Diversification policy is also considered a significant impact in creating a stable price. Modeling approach based on system dynamics provide less comprehensive results in the achievement of equilibrium prices. The model developed is only able to show a pattern of value price of rice is not at the desired price.

Appendix A. System Diagram

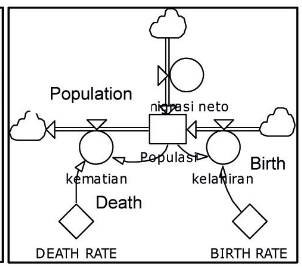


Appendix B. Stock and Flow Diagram

A.1. Subsystem GDRP & Population

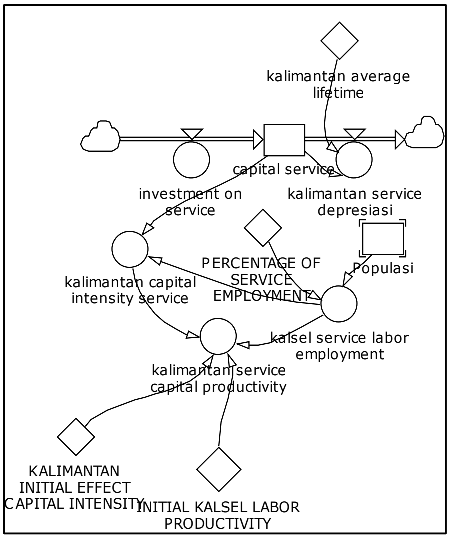


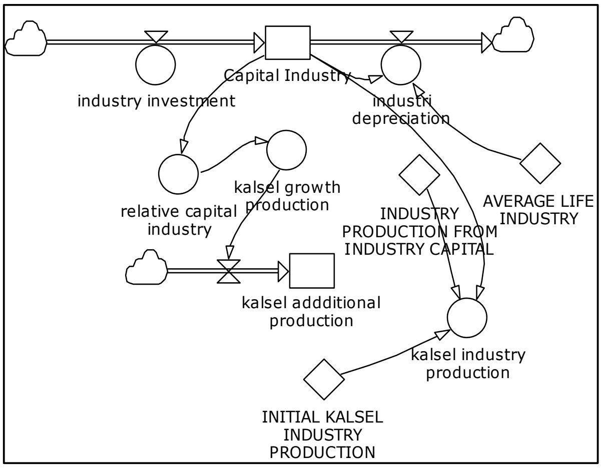
(a). Subsystem GDRP



(b) Subsystem Population

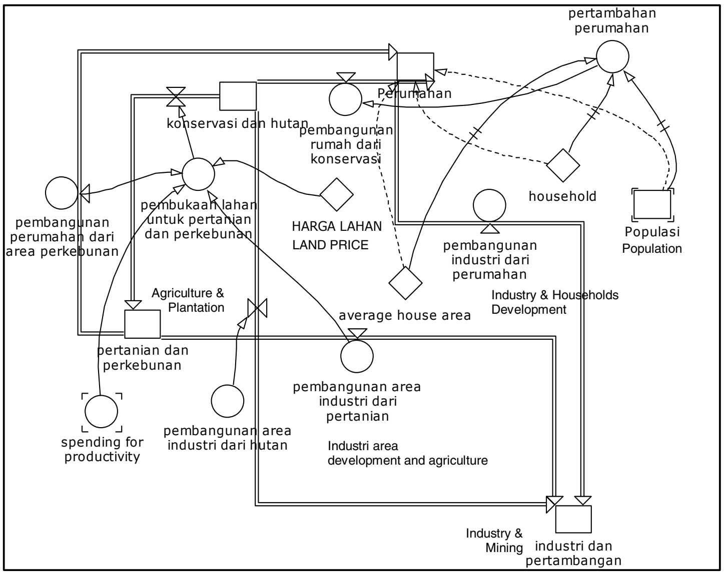
A.2. Subsystem Service Capital & Industry Capital



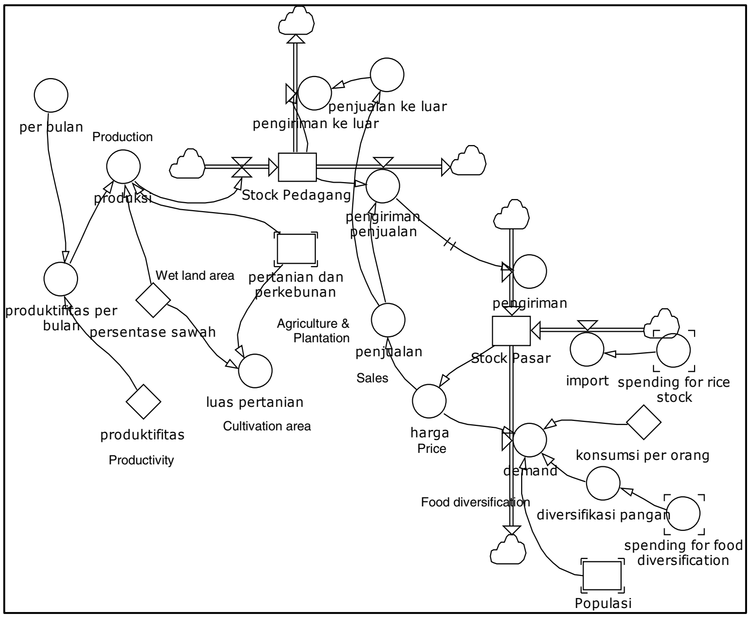


(a). Service capital (b) Industry capital

A.3. Subsystem Agriculture Area



A.4. Subsystem Production-Stock



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